Dryden Flight Research Center
Edwards, California 93523

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Revision E

DRYDEN HANDBOOK

CODE X

AIRWORTHINESS AND FLIGHT SAFETY REVIEW, INDEPENDENT REVIEW, MISSION SUCCESS REVIEW, TECHNICAL BRIEF AND MINI-TECH BRIEF GUIDELINES

Electronically approved by
Assistant Director for Management Systems

PURPOSE AND SCOPE

The purpose of this document is to maximize effectiveness of the airworthiness and mission success processes as practiced at the Dryden Flight Research Center.

This document presents the following: requirements/responsibilities of the Airworthiness and Flight Safety Review Board (AFSRB), the AFSRB Chairperson, and the Dryden Flight Readiness Review (DFRR) Committee when one is formed; a sample DFRR outline as a guide for the DFRR Chairperson's consideration during the review process; items that should be covered in the DFRR Committee report to the AFSRB; Mission Success Review requirements and guidelines; and Technical Brief and Mini-Tech Brief guidelines.

AIRWORTHINESS AND FLIGHT SAFETY REVIEW BOARD

The Airworthiness and Flight Safety Review Board (AFSRB) is tasked with performing certain review processes in order to ensure the flight safety of all projects conducted at Dryden Flight Research Center. The Dryden Organizational Manual (DOM) provides the authority for carrying out this task.

In order to implement the assigned task, the AFSRB is given the authority and responsibility to perform reviews that will vary depending upon the complexity and the criticality of the project under consideration.

The DFRC Center Director appoints the chairperson and the members of the AFSRB. The AFSRB members are the line organizational Directors, ex Officio members, the Chief Pilot, and the Chief of the Safety Office. Other U.S. Government personnel may be appointed to the AFSRB as necessary to provide a thorough review.

Airworthiness and Flight Safety Board Review

The first, though least extensive level of the AFSRB review is that conducted solely by the AFSRB Chairperson. The chairperson is responsible for determining whether a specific project need be reviewed in any further depth or by any committee. If project plans and preparations are adequate for performance of their proposed operation with the necessary level of safety, the chairperson has the authority to cease reviews at that point. This will be documented in an approved-to-proceed memo.

The second level of review is one step beyond the sole review of the AFSRB Chairperson. If the chairperson decides that a specific project needs further review but does not require the full airworthiness board review, the chairperson may convene a small team of Dryden experts, independent of the project, to assist in determining whether the proposed project is cleared for flight. If the chairperson and the small team agree that the project should be cleared for flight, this will be documented in an approved-to-proceed memo.

The third level of review is to have the plans and proposed conduct of the project presented to the entire AFSRB for review. In this case, the entire board will make a judgment as to whether a particular project has adequately considered and integrated flight safety into its proposed plans.

This determination will be based upon a presentation to the AFSRB by the project. The recommendation of the board to the Center Director will be based upon the general agreement of the members, with each major objection addressed and resolved. A quorum consists of the chairperson and representatives of Codes M, O, P, R, and S. Airborne Science projects require the presence of a Code Y representative.

The fourth level of review is to have the plans and proposed conduct of the project presented to the AFSRB by a team of experts, independent of the project, to determine whether the proposed project is cleared for flight. This team is called a Dryden Flight Readiness Review (DFRR) Committee. The entire committee will render a judgment as to whether a particular project has adequately considered and integrated flight safety into its proposed plans. The findings and recommendations of the DFRR team are presented to the AFSRB by the DFRR chairperson. The recommendation of the AFSRB to the Center Director will be based on the general agreement of the members, with each major objection addressed and resolved. A quorum consists of the chairperson and representatives of Codes M, O, P, R, and S. Airborne Science projects require the presence of a Code Y representative.

In any of the four review types, the AFSRB Chairperson has the authority to obtain assistance from any part of Dryden or any outside help that may be necessary to ensure that the project will be conducted in the safest manner possible. This assistance can take many forms, such as the hiring of a consultant, using the aircraft manufacturer's expertise, using experts in various fields, or forming ad hoc committees to assess any or all parts of the proposed program.

Dryden Flight Readiness Review (DFRR)

The AFSRB Chairperson may establish a formal DFRR to assist in evaluating whether a specific project is adequately prepared to proceed with its proposed program. Typically, a DFRR should be convened if any of the following criteria are present:

1. Any new program or operation that can reasonably be assumed to contain significant risk to personnel or property.

2. A phased program that is ready to enter a second or succeeding phase beyond that already approved by the AFSRB.

3. A program that is preparing to exceed some limit previously approved by the AFSRB.

4. A program that will require a major modification to the aircraft.

The DFRR must be established at a time when credible review and assessment can be made without delaying the operational schedule of the project, but in all cases, before the first flight or major operation of the project. DFRRs are normally limited in scope to addressing safety as the main subject of review but may also include a Mission Success Review charter.

A DFRR Committee is charged with:

1. Conducting an independent review and assessment of the entire program or operation and assure that proper, adequate planning and preparation have been accomplished, resulting in the project being conducted in an acceptable, safe manner. This review should include, where applicable, the design, fabrication, performance, and documentation of all software and hardware associated with the project as well as ground and flight operational procedures. It should also include any substantiating wind tunnel, computational fluid dynamics, ground, and/or simulation testing that has been performed.

2. Verifying that the approved System Safety Plan has been followed and that all analyses and results have been properly integrated into the project's planning and tracking documentation.

3. Ensuring that all identifiable risks have been identified, assessed and either adequately controlled or presented to the Center Management as risks that must be accepted in order to conduct the program.

4. Providing engineering and technical recommendations to program personnel throughout the life of the DFRR, while recognizing that it is not a function of the DFRR to direct actual work effort.

5. Maintaining ongoing communication among DFRR members, program personnel, DFRC management, and the AFSRB Chairperson.

6. Submitting a final report on Committee activity, findings, and recommendations to the AFSRB Chairperson.

The membership of the DFRR Committee is selected to represent specific functions and disciplines necessary for an objective review and assessment of a project and its proposed plans. Broad experience and expertise are desirable among committee members in order to assure recognition of potential problems in a wide range of areas. Members will not be associated with the program being reviewed in any manner such that their activities or recommendations may be influenced through such causes as an over-familiarity with the project. The chairperson of the DFRR committee, a DFRC civil servant, is a senior engineer with extensive experience and expertise in the project's primary discipline. Other members may be drawn from NASA field centers and from the private sector as long as they are independent from the project under review.

The members of this committee may go to their respective supervisors and/or the Safety and Mission Assurance Office for help or advice in interpretation of the committee's charter. It is extremely important, however, that the individual member remain totally independent from line management biases while operating as a committee member. The line management has the responsibility to ensure that individuals working under them are given the time and priority necessary to do a thorough job as a committee member.

The committee should take advantage of other advisors and consultants to assist them in fully reviewing the project. If an outside consultant must be hired, the project should provide funding. Decisions and recommendations are the sole responsibility of the committee and its chairperson.

One purpose of the DFRR review is to expose individual or committee concerns to higher management and the project while there is still time to avert a mishap. Therefore, project team members are encouraged to reveal information freely, cooperate with the review team(s), and be totally open in all exchanges, including those detailing any doubts or uneasiness experienced by the project team. Inviting the DFRR Committee members to attend pertinent project meetings wherever applicable can emphasize this. The Project Team and the DFRR Committee have a common goal and often the DFRR Committee can help the project in attaining this goal. Briefings by the project team should be presented by qualified personnel to familiarize the committee with overall efforts and specifics of all areas under evaluation. It is the responsibility of project personnel to assure that all information presented is current, complete, and accurate, that all hardware, software, and equipment submitted for evaluation is properly prepared and represents actual configuration and functional characteristics intended for use, and all known or suspected anomalies, deficiencies, or areas of concern are identified.

Constant communication between the DFRR Committee and the project team can provide benefits in both directions. A concern or recommendation voiced to the project team in a timely manner may allow the project to take action without delaying the project. Likewise, the proposed action of the project team, communicated to the DFRR Committee in a timely manner, may expose areas of confusion or misunderstanding on the part of either the committee or the project that could lead to unnecessary expenditure of valuable time and/or resources.

Upon completion of the committee’s review, the DFRR chairperson will prepare a report for the AFSRB chairperson. This report should be presented in writing to the AFSRB chairperson. This report should include the committee’s recommendations, any unsatisfactory or marginal areas or conditions, any restrictions or limitations that should be imposed before the proposed operation may take place, and a discussion of any hazards that must be presented to the Center Director for acceptance. Ordinarily, the report should be signed by all DFRR Committee members, but the chairperson may sign in an individual’s absence if he states that the absent member either concurred in the majority report or has filed a minority report. Any member not concurring with the majority report should submit a minority report stating any areas of non-concurrence or additional claims or recommendations as appropriate. Typically, the DFRR chairperson will present an oral briefing to the AFSRB. The written report should be delivered to the AFSRB and the Project Manager at least 48 hours prior to the AFSRB meeting.

The DFRR oral briefing to the AFSRB should include the material presented in the written report. Typically, the DFRR chairperson and DFRR committee members will present the briefing. Project team members should be present to answer very specific questions that may arise. Hard copies of the oral presentation should be prepared and presented to the Project Manager and AFSRB members 24 hours prior to the AFSRB meeting.

Along with the presentation of the DFRR Committee’s final report, the Project Manager of the affected project will submit a report to the AFSRB chairperson addressing any open action items or recommendations that may have been in the DFRR report that require action before the first flight or significant project operation. Following these two report submissions, the AFSRB will make final recommendations as to whether the project should be allowed to continue on the planned course or should undergo some plan modification before continuing.

In order to allow sufficient time for the AFSRB to arrive at a decision without undue pressure, the final DFRR briefing to the AFSRB must precede the Project's Technical Briefing by a minimum of three workdays. It is also important to note that the Technical Briefing should precede the first flight/operation by a minimum of two working days. The DFRR Committee should be present at the Technical Briefing in order to concur on closures of any issues that were deferred to the Tech Brief. For smaller projects less broad in scope, the above times may be compressed.

DFRR Outline

The outline in Appendix 1 is offered for the DFRR chairperson's consideration when conducting a DFRR of an assigned project. The committee's primary concern is to investigate all matters that affect public, flight, range, and ground safety. Any items noted that may affect mission success may be reported, but are not the primary concern of the committee.

Mission Success Review

A Mission Success Review (MSR) may be conducted at any time in the life of the project to ensure the highest probability of success. The content, defined by the AFSRB chairperson, is tailored, so will vary from project to project. The review normally will be conducted and presented by the project team but the AFSRB chairperson may establish a special team to conduct the review. The MSR may be done separately or in combination with a safety review. The MSR findings will be presented to the AFSRB as a written report followed by an oral presentation no sooner than two days after receipt of the written report.

The MSR team may be commissioned to review:

1. Project or program requirements to verify that they are clear and that mission success will satisfy the requirements.

2. The flow-down process, to assure that derived requirements for subsystems are traceable to the project requirements.

3. Project risk assessment to see that all reasonable risks to mission success have been identified, assessed, and dispositioned or presented to Center Management as risks that must be accepted in order to conduct the program.

4. The design, fabrication, performance, and documentation of all software and hardware associated with mission success.

5. Substantiating wind tunnel, computational fluid dynamics, ground testing, flight testing, and simulation testing that have been performed, including off-nominal

conditions.

6. The data acquisition and manipulation plan.

7. The flight planning and envelope expansion process.

8. Test range and control room operations, communications paths.

9. Cost estimation methods

10. Project schedules and milestones for reasonableness and conformance, project reviews and problem reporting and resolution methods

Technical Briefs and Mini-Tech Briefs

The Technical Briefing, or Tech Brief, is one of the more important tools used by Dryden to insure the safe and efficient conduct of the flight test mission. Its major function is to continue the review process after the AFSRB has made its final recommendations and a program moves into the flight phase.

There are two primary purposes for holding Tech Briefs. First, the individual Project Office is given the opportunity to present its goals and plans to a group of peers. These peers represent all the various disciplines at Dryden, with special emphasis on the particular areas of interest that are being explored during the proposed flight tests. A Project, in this way, receives the benefit of the experience and expertise of projects conducted previously. The peer review, using past experiences, is a proven way of bringing overlooked items to light.

The second purpose of Tech Briefs is to present a current assessment of Project risks to the Dryden management team. It allows management to reconsider its understanding of the risks involved prior to each flight. This helps ensure that any risks that cannot be eliminated or reduced will be accepted at the appropriate level of authority and responsibility.

Holding a Tech Brief prior to each flight of a research aircraft allows an adequate amount of time to process and thoroughly review data received from the previous flight. This forces a more comfortable, and safe, pace without project participants feeling they are being rushed into proceeding with a flight program after only a cursory look at available data.

The Project Manager is responsible for both scheduling and presenting the Tech Brief. The presentation should include, where applicable, the following:

A. A review of past flight(s) -

This review should address the data analysis results from previous flights of the aircraft with particular emphasis on envelope expansions or any unexpected results, whether or not they are expected to present a problem. These results should provide a smooth transition to the objectives of the proposed flight plan. Pilot comments from past flights should be addressed, particularly where the flying qualities of the aircraft are unexpected or not as good as have been expected. Significant anomalies or failures from previous flights must be reviewed.

B. Objectives of the proposed flight -

The objectives of the flight should be presented in light of the results of previous flights and as part of overall program objectives. Rationale and justification for the proposed flight should be shown based on an orderly progression from data points already obtained.

C. Flight Plan -

The planned approach to obtaining the data maneuvers should be explained with emphasis on the technique and rationale for using it. Any risks, limits or constraints on the aircraft or maneuvering should be presented and clearly explained with no assumptions made as to understanding of these critical areas. Preplanned alternatives should be presented to allow for unforeseen contingencies that may occur during flight. This plan should cover the entire flight period from takeoff to landing and give a clear and concise understanding of the pilot's duties at all times. If there is to be a period of pilot familiarization during flight, that should be briefed at the Tech Brief. This is not meant to limit the pilot's freedom, but to constrain all research aircraft flying to activity that has been preplanned and briefed.

D. Configuration Changes -

A brief review should be made of the configuration that the aircraft will be in for flight. This is particularly important where there has been a change made to the aircraft between flights, no matter how small or seemingly unimportant. Additional risks perceived to have been incurred as a result of the changes must be briefed in the Tech Brief.

E. Control Room Operations-

For those Projects requiring a control room, the presentation of the Control Room procedures should include the room layout, the people involved in the flight, data they will be looking at and for, and instrumentation requirements. Any changes to the room or its functions should be explained and the communication network, both with the aircraft and in the Control Room, should be briefed. Any control room training accomplished or needed prior to flight should be included.

F. Accepted Risk List -

Every Tech Brief must present a list of any risks that are being taken knowingly by the Project. These risks may have arisen through various analyses such as a Hazard Analysis or may have shown up on previous flights or tests as discrepancies and processed through the normal Discrepancy Reporting system. In either case, the associated risk and the authority for accepting it must be clearly explained and justified.

G. Mandatory Requirements -

Every flight of a research aircraft will have a specific set of personnel, instrumentation, and equipment required in order to conduct the flight as planned. This list must be presented at the Tech Brief along with the action to be taken in the event a person or item is not present or not operating. These could include cancellation, flight abort, or deletion of a specific maneuver or series of tests, but the goal is that all possibilities will be given detailed consideration in advance of the mission and precise alternatives planned and prepared for. This list should include all personnel required in the Control Room operation.

H. Open Items -

Occasionally, items may represent a major problem area and the Project is delayed until the items can be closed out satisfactorily. More often, the items are less severe and simply lack the necessary information at the time of the Tech Brief. These may normally be carried forward and closed out at the Crew Brief before the Project is cleared to proceed.

Technical Briefings must be scheduled a minimum of two working days in advance of the proposed flight date. If not, it is the responsibility of the Project Manager to personally contact each of the mandatory attendees and notify them of the upcoming briefing. Actual scheduling is done through the Aircraft Operations Scheduling Office but remains the responsibility of the Project Manager. He must also be sure the Aircraft Operations Scheduling Office is informed of any changes so the bulletin board in the Flight Operations Directorate Office can be kept up-to-date. The keeper of the Dryden Center Calendar should be notified as soon as a date and time has been established so that no conflicting meetings will be scheduled. Dryden management has given the Tech Brief the highest priority.

The presence of the following individuals or designated representative is considered mandatory before a Tech Brief may be conducted. In the event any individual, or a designated representative, is not present the Project Manager will cancel the Tech Brief and reschedule it at a later date.

Project Manager
Project Pilot
DFRC Chief Engineer (Tech Brief Committee Chair)

Director, Research Engineering
Director, Aerospace Projects or Airborne Sciences as appropriate
Director, Flight Operations
Director for Safety and Mission Assurance
Director, Research Facilities

Desired attendees:

Principal Investigator
Designated technical monitor(s) (for each project) from Research Engineering

It is desirable for DFRR Committee members to attend the first Tech Brief after their report to the AFSRB to ensure that actions directed by the AFSRB have been complied with by the Project. It is the responsibility of the person chairing the DFRR to notify the members regarding the Tech Brief.

Directorate management must assure that designated representatives report issues and results to the directorate management to insure continuity of directorate technical and safety monitoring.

It is the responsibility of each individual on the Mandatory Attendance list to maintain a current list of designated representatives who may attend Tech Briefs in his/her absence. A copy of the proposed flight request/mission plan will be made available in each of the Directorate Offices at least one day prior to the scheduled Tech Brief. It has been customary to circulate a draft of the proposed plan to all the interested parties a few days in advance of the Tech Brief. This is a desirable policy and should be exercised whenever possible. It provides the attendees with the benefit of being fully prepared at the Tech Brief as well as giving the Project Team the benefit of potential feedback at a much earlier point in the planning process. It also will allow each of the mandatory attendees enough time to insure that they or their representatives can attend the actual briefing. Following the Tech Brief, the Directorate Directors (Operations, Projects or Airborne Science, Research Engineering, and Research Facilities) will approve and sign the Flight Request Form. The Chief Engineer will sign the Flight Request Form to indicate approval to conduct the operation.

Any of these rules may be altered to fit a special case through negotiation with the Chief Engineer's Office. One example of a rule change that is permitted is the "Block Tech Brief," where a series of flights is briefed collectively. This would also include aerial refueling of a research aircraft where "one" flight is, in effect, two or three normal ones.

Although block briefing is often allowed, there is good reason and benefit from having the Project take the necessary time between flights to analyze data before proceeding with the flight program. This is especially true where an envelope is being expanded and data maneuvers proposed for a flight are highly dependent upon results from a previous flight. The usual technique is to expand the envelope on the first flight of a series and then use the remaining flights to fill in data points, or to expand an envelope in a different disciplinary area. A Tech Brief is then conducted before further expansion takes place.

A "Mini-Tech" covers only a limited new agenda aimed at a few items requiring clarification before continuing with a flight series. It is not a substitute for a Technical Briefing. Approved agenda items are: prior flight results, relatively minor changes in configuration, prior flight anomaly explanation and analysis, minor changes to the Tech Briefed flight plan, and close-out items from Project reviews. Items covered at the Tech Brief must be readdressed, but may be covered by a statement such as " F. Accepted Risk List: No changes from the Tech Brief".

The "two day before flight" requirement is relaxed with Mini-Techs to facilitate a safe but rapid conduct of the mission. A Mini-Tech may be held immediately prior to the Crew Brief for most block-briefed flights, after the first flight.

The signatures of the appropriate entities on the previously briefed Tech Brief Flight Request must be reaffirmed by signature and dated. The signatures show approval of the flight as briefed at the Tech and Mini-Tech briefings.

The final decision on what will or will not be allowed for any given project remains a decision to be made by the DFRC Chief Engineer, a decision based on what will facilitate the safest and most efficient flight test program possible.

APPENDIX 1

REVIEW BOARD CHECKLIST

The purpose of a review is to provide NASA management assurance that a satisfactory approach has been taken to achieving safe and productive flight operations. Reviews communicate an approach, demonstrate an ability to meet requirements, and establish current status.

The objectives of a review are: to establish that all interfaces are compatible and function as expected, confirm that the system and support elements are properly configured and ready for flight, and to receive assurance that flight operations can proceed with acceptable risk.

This checklist provides a non-exhaustive list of items to address for review team guidance when conducting an independent review. The team may select only those items that apply to the project reviewed. The list draws heavily from the Mars Climate Orbiter investigation.

1. PERSONNEL

(a) Leadership

- Emphasis on safety as the primary concern
- Experience level of personnel
- Clear line of authority to person in charge
- Examine team working and external interfaces.
- Teamwork promotion.
- Training opportunities provided
- Mentoring of new or inexperienced personnel

(b) Organization and Staffing

• Sound organizational structure
• Staffing adequacy
• Customer representation
• S&MA representation

(c) Communication

• Ranking of safety and mission success over cost and schedule
• Free exchange of information, opportunity to be heard
• Tracking of top ranked issues and their resolution to everyone's satisfaction
• Problem reporting encouraged
• Line organization and project communications

(d) Project Team

• Key positions filled and continuity encouraged
• Experience level of team members
• Adequacy of project team's reviews: PDR, CDR, Wind tunnel, test readiness, simulation
• Customer involvement in decision-making and trade-offs
• Team acceptance of external ideas
• Team metrics relation to requirements

2. PROCESS AND EXECUTION

(a) Systems Engineering

• Risk trade-off system used by the project
• Risk management system used
• Ground test versus flight test trade-off
• Fault tree analysis used
• Margin adequacy for parameters
• Mission architecture provides data for failure analysis
• Emphasis on mission success over cost and schedule
• Formal review of past lessons learned
• Rigorous configuration control process in place.

(b) Requirements

• Mission success criteria established and baselined.
• Requirements level sufficiently detailed.
• Change process used and effective
• Derived requirements flow from base requirements

(c) Validation and Verification

• Verification matrix structure and completeness
    Vertical: Mission phase or hardware part or software
    Horizontal: Function, qualification method (analysis, test, similarity, none), results
• Sound verification processes
• Evidence that processes are used
• Mission critical software identified and treated as such

- System interface validation and data handoff
- Simulation as a verification and validation tool
- Other validation and verification facilities
- IV&V for software
- Normal and off-nominal (contingency and emergency) testing
- Test repeats after configuration changes
- End-to-end testing results and configuration freeze

(d) Cost and Schedule

- Funding adequate to accommodate program
- Bottom-up budget and schedule
- Cost and schedule reserves
- Mission success compromise for cost

(e) Government and Contractor Roles and Responsibilities

- Roles and responsibilities defined (written), workable, and followed
- Experience level of contractor work force

(f) Risk Management, Analysis, Test

- Risk relationship to cost, schedule, and content of project.
- Risk analysis tools used: FMEA, FTA, PRA, etc.
- Problem-reporting procedures
- Single-point failures identified and remedied or accepted
- Hardware and software reuse certification
- Day-of-flight configuration testing
- Potential failures identified, modeled, and overcome or accepted
- Thoroughness of failure postulation

(g) Independent Reviews

- Review conducted by technical peers or experts
- Sustained support for review members
- Review independence from common management
- Review results reported to top management

(h) Operations

- Contingency planning validated and tested (simulated)
- Contingency training of personnel
- Mission Rules formulation and reasonableness
- Telemetry and health monitoring during critical operations

(i) Center Infrastructure

• Senior management mechanisms for visibility into the project
• Line organization accountability

(j) Documentation

• Documentation of design decisions and limitations
• Decisions communicated to all concerned
• Documentation process must be continuous
• Electronic documentation distribution availability

(k) Continuity and Handover

• Transition plan for handover
• Personnel transfer with handover
• Recipient team training by development team
• Training of recipients in procedures and databases.
• Continuity in key positions; overlap
• New processes generated by the transition
• Transition risks

(l) Mission Assurance

• Adequate mission assurance staffing
• Mission success processes in place and followed

3. TECHNOLOGY

• Technology adequately matured
• Technology solutions alternatives considered
• Risk level of new technology
• New technology use and limitations

4. TECHNICAL AREAS

View technical areas with the purpose, goals and objectives of the Project in mind.

• Aerodynamics
    Control surface effectiveness
    External pylons, stores, protuberances, fixtures, mounts
• Alternate landing sites

• Aircrew
    Aircrew Evaluation of Simulation Results, aircraft readiness, problem areas
    Guest aircrew in-briefing
    Review of Flight Crew Training, Procedures, and Qualifications
• Avionics
    Redundancy, reliability
    EMI testing
• Carrier Aircraft (Mothership)
    Crew qualifications
    Communications paths
    Interfaces, launch panel
    Pylon, hooks, sway braces
    Separation analysis
    Sling loads
• Computational Fluid Dynamics analysis
• Configuration Control
    Project Requirements
    Flight vehicle under configuration control
    Hardware
    Software
• Control Room Operations
    Communications Links
    Display and Layout: Monitoring and Analysis
    GRIM
    Key Personnel and replacements
    Security
    Uplink capability
• Data acquisition and transmission
• Documentation
• Experiment(s) Description
• Flight Envelope and Expansion Plans
• Flight Controls
    Flight controls computers and software functions
    V&V, IV&V
    Certification Standard (Level A: Flight Critical)
• Fuels and oxidizers: hypergolics, pyrophorics, oxygen
• Ground Operations and servicing
• Ground Support
    Airfield Facilities
    Communications Equipment
    Ground Support Equipment
    Maintenance Facilities
    Navigation, Guidance, and Landing aids
• Ground Testing
    Communications
    Drag chute and deploy mechanism
    Free taxi operation (disconnected from tow)

  - Ground track
  - Outside air temperature limit
  - Steering method
  - Support vehicles
  - Tow operations and tow connector link
  - Wind and Crosswind limits
- Guidance, Navigation, and Control onboard
- Handling Qualities
  - Predictions: Simulation, analog
- Hazard Analysis
  - Hazard identified
  - Severity and Probability levels
  - Risk Matrix
  - Accepted risks
- Human Factors
- Hydraulics
  - Redundancy
- Inspection methods at contractor's location and at DFRC
- Instrumentation
  - Air data system, FADS, pilot, computer influence
  - Go/No go
  - Mishap reconstruction capable
  - Research data acquisition
- Life Support
  - Anti-G suit
  - Egress capability
  - Parachute characteristics, fit compatibility
  - Pressure suit
  - Sharp edge survey
- Mission Rules
  - Limitations
  - Operational restrictions
- Operations
  - Checklists
  - Emergency Procedures
  - Fact Sheet
  - Manuals
- Parachutes, Vehicle
  - Construction
  - Pyrotechnics, Mortar
- Pilot training (ground and flight)
- Project Overview
  - Experiments Planned
  - Facilities required
  - Hardware, Software
  - Objectives
  - Procedures used

- Propulsion
  - Launch vehicle
  - Research vehicle
- Range Requirements
- Range Safety
  - Abort landing sites
  - Beacons
  - Command Destruct System
  - Encryption
  - Expected casualty calculations
  - Flight Termination System
  - Operating area
  - Trajectory
- Recommendations by the Review Board
  - Action Items
- Research Vehicle
  - Vehicle purge
  - Landing gear
  - Mass properties
  - Pilot intervention for UAVs
  - Thermal protection
- Risk Management
  - Assessment of residual risk
  - Accepted Risk List
  - Hazard Identification
  - Severity and probability matrix
- Simulation
  - Certification: qualified for use
  - Configuration Management
  - HIL, AIL
  - Nominal, off-nominal testing
  - Verification
  - Validation
- Software
  - Configuration Control
  - IV&V
  - Simulation
- Stage Separation
  - Aerodynamics
  - EMI
  - Ordnance
- Structures
  - Aeroelastic effects
  - GVT
  - SMI
  - Sideslip-dynamic pressure combination (ßqbar)

- Uncertainty Analysis
  - Margins
  - Monte Carlo Analysis
- Validation and Verification
  - Validation: System performs adequately to accomplish the mission: Test, Analysis, Demonstration, Similarity, Inspection, Simulation
  - Verification: System performs according to the specification: Test, Analysis, Demonstration, Similarity, Inspection, Simulation
  - All-up, end-to-end check: Thermal, vibration, shock, pressures, etc., combined
- Vehicle Health Monitoring
- Waivers
- Wind tunnel predictions
- Wiring
- Work Breakdown Structure

SAMPLE QUESTIONS FOR REVIEW BOARD MEMBERS

MODIFICATIONS

1. Can the type and amount of power available support the electrical requirements of the installations?

2. Have operating procedures and an inspection checklist been developed for the installation?

3. Is cooling air adequate to properly cool avionics? In flight? On ground?

4. Have partial flight manuals and checklist been prepared and approved?

5. Have weight and balance figures been computed and are they within recommended limits?

6. Does the installation of test equipment in the aircraft interior keep aisles and emergency exits clear for evacuation?

7. Do installed racks and test equipment have projections (bolts, rivets, knobs, handles) which could cause injury to aircrew personnel?

8. Does instrumentation installed in the cockpit obstruct vision or egress or add discomfort and distraction to the aircrew?

9. Is the aircraft properly placarded and has the test instrumentation in the cockpit been properly identified and marked?

10. Do any external modifications affect the pitot-static system?

11. Have magnetic interference (RMI) ramifications been considered? Will flight day RMI be different than other days?

12. Have modifications been photographically documented on film or video?

13. Review fact sheet. Are all changes incorporated?

INSTRUMENTATION

1. Has the proposed and/or completed installation been inspected by the project test aircrew to ensure that it offers the safest possible installation? Has a cockpit safety design board approved the changes and documented approval?

2. Has a complete set of operating instructions been formulated and published?

3. Are the instrumentation appendages (nose boom pitot head, vanes, etc.) ahead of the engine checked regularly for structural integrity?

4. Has proper consideration been given to the separation of shielding of instrumentation and aircraft wiring, especially in the area of weapons system control circuits?

5. Have provisions been made for coordinating the data when more than one recording device is to be used?

6. Have adequate written procedures been developed for the maintenance, inspection, and calibration of the instrumentation?

7. Has a complete set of emergency or alternate procedures for test instrumentation failures been formulated in order that some part of a scheduled mission can be accomplished safely with certain instrumentation inoperative?

8. Are you reasonable certain that this test can be conducted safely?

9. Is it necessary or advisable to monitor internal black-box temperatures monitored? Inflight? On ground? During build-up and maintenance?

10. Are black boxes instrumented to reveal elapsed operating hours? On-off cycles? Are hours and cycles frequently monitored and documented?

11. Are film/tape time limits on recorders and cameras understood? Speeds? Initiation and shutoff times?

12. Has the instrumentation installation been documented by photography/video prior to flight?

MAINTENANCE

1. Are there any special maintenance procedures that will be required to support the test? Are they published as a requirement?

2. Have inspection requirements been compiled into preflight, post-flight, and phase documents?

3. Have the aircraft and, in particular, the modification areas been thoroughly inspected for foreign objects?

4. In the case of joint maintenance support, who is in charge?

5. Are you reasonably certain that the test can be conducted safely?

FLIGHT CONTROL ROOM-FLIGHT OPS

1. For each flight test maneuver or event:

    - Who are the key people monitoring the event? Are they properly trained?

    - What recorders, channels, and parameters are being monitored for critical and precautionary indications?

    - What are the critical and precautionary limits for the given event?

    - Is there any question concerning whom you notify, how you notify them, and with what urgency? Are there any questions concerning how you expect people to react when you notify them of a critical or precautionary indication?

2. Is there any question concerning the parameters monitored, type of sensor used, or the method of display?

3. Are you satisfied with the limits and accuracy of the monitored parameters? With interfaces with other monitored parameters?

4. Have you checked scaling and sensing (direction) of the parameters you are to monitor?

5. Are you satisfied with your communication network, procedures and equipment?

6. Are flight envelope limits clearly defined and understood before flight by necessary persons?

7. Will you be able to detect faulty instrumentation indications of critical flight parameters?

AERODYNAMICS

1. Have all aspects of new design or modification been considered for effect on aerodynamics? Weight? CG? Inertia? Exterior Configuration? Surface control movements? Pitot-static system? Other instrumentation? Etc.?

2. Have effects of in-flight unplanned alteration of appendages or flight surfaces been assessed?

3. Is the aero model satisfactory? Any undue concerns? How are you going to verify the aero model during envelope expansion flights?

4. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

5. Is instrumentation satisfactory? Does it tell you all you need to know for safety and mission accomplishment? What are the shortcomings?

6. Do you have any undue concerns about questions in the “Flight Control Room Flight Ops” section of this document?

7. Have all safety and mission concerns been adequately addressed?

8. Are you reasonably certain flight can be conducted safely?

AEROSTRUCTURES

1. Have all aspects of new design or modification been considered for effect on structure and vice-versa?

2. Are ground load and ground vibration tests adequate? Any evidence of airframe vibration (flutter, buffet, acoustics)?

3. Is instrumentation satisfactory? Does it tell you all you need to know for safety and mission accomplishment? What are the shortcomings?

4. Do you have any undue concerns about questions in the “Flight Control Room Ops” section of this document?

5. Have all safety and mission concerns been adequately addressed? What factor of safety in design or test? What Margin of Safety?

6. Are you reasonably certain flight can be conducted safely?

CONTROLS (FLIGHT, ENGINE, ETC.)

1. Have all "fail to operate" and full hardover impacts been assessed?

2. Is the system implemented as intended by the designer? How is it assured?

3. Have end-to-end tests been conducted on the full-up total system? Have all credible inputs been accomplished to observe system response?

4. Do all lights and indicators obtain intelligence from credible sources?

5. How does failure or erroneous signal in a light or indicator impact safety or mission accomplishment?

6. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

7. Is there a “last resort” provision to switch back to a previously annunciated failed system in the event vehicle loss is imminent regardless? (i.e., the system may be healthy with the warning system malfunctioning.)

8. Have all prudent efforts been considered to continue operating system in a degraded “get-home” condition in lieu of switching to a dormant or benign backup system whose health is not utterly known?

9. Has consideration been given to using parallel-active dual systems rather than primary-active, backup-benign systems?

10. In the event of a failure, will an impacted item be automatically positioned at an optimum setting (i.e., engine speed, flight control surface, etc.)?

11. Do you have any undue concerns about questions in the “Flight Control Ops” section of this document?

12. Have all safety and mission concerns been adequately addressed? Has a system safety assessment been accomplished?

13. Are you reasonable certain flight can be conducted safely?

MAN/MACHINE DYNAMICS

1. Have all aspects of new design or modification been considered for effect on dynamics and vice-versa? Weight? CG? Inertia? Exterior configuration? Surface control movements? Pitot-static system? Other instrumentation? Etc.?

2. Have effects of unplanned alteration of appendages or flight surfaces been assessed?

3. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

4. Is instrumentation satisfactory? Does it tell you all you need know for safety and mission accomplishment? What are the shortcomings?

5. Do you have any undue concerns about questions in the "Flight Control Ops" section of this document?

6. Have all safety and mission concerns been adequately addressed?

7. Are you reasonably certain flight can be conducted safely?

PROPULSION

1. Are propulsion characteristics compatible with the intended flight envelope? Altitude? Speed? G-force? Angle of attack? Sideslip?

2. Where is flameout or engine stall anticipated?

3. Are procedures adequate to avoid overtemp or other engine damage?

4. Are engine recovery procedures adequate?

5. Is testing in an area where emergency power-off landing can be safely conducted?

6. Are flight control and electrical/hydraulic power adequate for power-off landing.

PROJECT MANAGEMENT

1. Have all the policies of Dryden Management System Manual (DMSM) been addressed?

2. Has a review of all system safety documentation been accomplished?

3. What are your mission rules and accepted risks?

4. What configuration control process is utilized?

5. Has the Project utilized appropriate Lesson Learned databases?

Document History Log

This page is for informational purposes and does not have to be retained with the document.

Status Change	Document Revision	Effective Date	Page	Description of Change
Baseline		3-2-99		
Revision	A	4-21-99	1, 2, 15, 16, 17	Modified this Document History Page, changed DMI 79400.1 to DOM, corrected misspelled word (erroneous), changed BOM to DMSM, and Added Question #5.
Revision	B	8-27-00	3, 19	Modified 2nd paragraph on page 3 and last sentence on page 19
Revision	C	11-9-99	All	Modified punctuation on pg. 3, changed facility to DFRC in paragraph 5, pg. 4, removed last sentence on Paragraph 1, pg. 5, Modified punctuation on pg. 5, changed minimum of 3 days to 2 days in last paragraph on pg. 6, Corrected grammar, moved Director of research facilities from 2nd list to 1st list pg. 20, Changed Division to Directorate in first paragraph, pg. 21, added “or airborne science” to 2nd paragraph pg. 21, changed 3 to 2 days in paragraph 5 pg. 21, Modified grammar on pg. 22
Revision	D	9-1-00	All	Entire document modified.
Revision	E	5-9-03	2, 3, 4, 5, 6, 10	Changed “Dryden Independent Review (DIR)” to “Dryden Flight Readiness Review (DFRR)” throughout. Minor edits throughout.